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PURE CHRONOLOGY

ON

A UNIVERSAL BASIS.

LONDON:
PRINTED BY THOMAS DAVISON, WHITEFRIARS.

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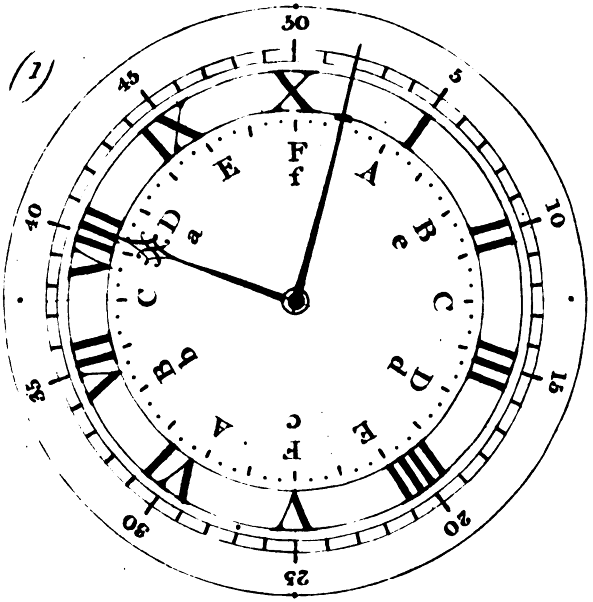

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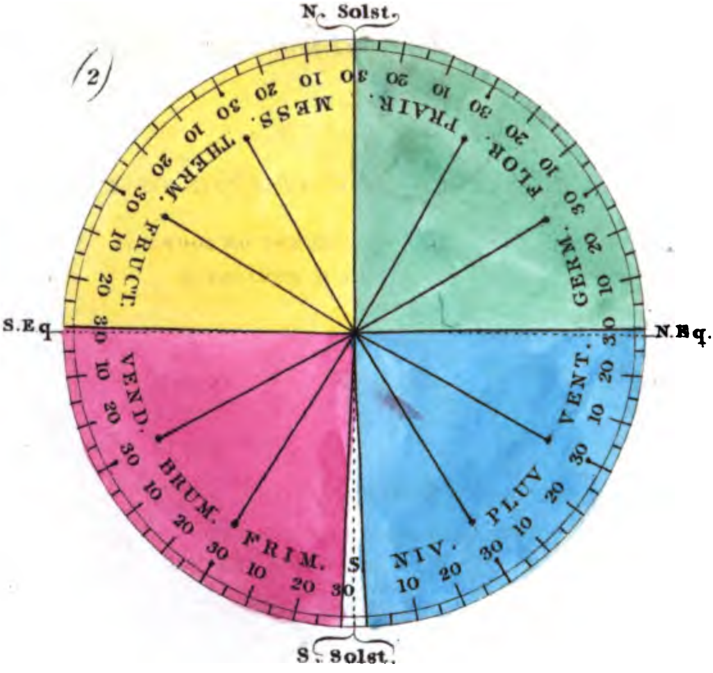

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PURE CHRONOLOGY

ON

A UNIVERSAL BASIS:

BEING

AN ATTEMPT TO SYSTEMATIZE AND UNIVERSALIZE

THE DIVISION OF TIME;

CONTAINING,

AMONG OTHER MATTERS, A PROPOSAL FOR A NEW STYLE,

OR EQUIALTITUDE CALENDAR;

AND

A NEW SYSTEM OF EPACTS BELONGING TO THE SAME.

WITH

A PROPOSAL FOR A NEW DESCRIPTION OF TAX,

TO BE LAID NOT UPON IMPROVEMENT OR COMFORT,
BUT UPON IGNORANCE AND PREJUDICE.

LONDON:
PUBLISHED FOR THE AUTHOR,
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170.

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DEDICATION.

To those who set a just value on the importance of general notions, and who place mental science at the head of all other less comprehensive sciences, the following tract is most humbly and respectfully offered for inspection and correction, by a hearty well-wisher to the improvement of the human race.

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PURE CHRONOLOGY,

&c.

Of the Arithmetical Scale.

There can be little doubt that the ten fingers of the hands were the occasion of our numerical scale, when, in the infancy of language, signs were substituted for words to express our notions. It was then natural to fix the basis of computation at ten, which accordingly determined the position of the cipher.

Some have proposed to remove the cipher from its present situation at 10, to 8, 12, or 16. But it should be shown with what arithmetical advantages such an alteration would be attended; and, as in all these systems of numeration there must be rules for performing arithmetical operations, it should be shown that these operations can be performed more easily in one system than in another. As, in all probability, this cannot be shown, there seems to be no argument of sufficient weight for deserting the present system, the scale of which nature itself seems to have settled, and which is, at present, our only universal language.

Those who propose an abandonment of the decimal scale seem not to have reflected upon the almost utter impossibility of its accomplishment. This is, however, what few would seriously propose; it being mostly an excuse brought forward merely to vindicate the arbitrary and inconvenient divisions of time and space, on the grounds of some few alleged advantages.

Of the Two Principal Unities of Time.

In the practical division of time, two principal unities are offered to our consideration, both of which are indispensable to our wants. These are the *day* and *year;* the former marked out by the apparent return of the sun to the same meridian; the latter, by that of the sun to the same solstice.

The variable solar day, by being equated, gives place to the *mean solar day.*

In like manner the variable solar year gives place to the *mean solar year.*

As the year is the greater unit, we compute upwards by decimal multiples of this unit.

As, also, the day is the lesser unit, we ought to compute downwards by decimal fractions of this latter unit, unless we abandon the scale of our arithmetic, which follows the same progression. To contradict this, is to affirm that what is predicated generally is not to be predicated particularly, or that entities may be multiplied beyond necessity; contrary to long established principles of logic and philosophy.

Hence the following tables.

Ascending scale.

100 *years* = 1 *century.*
100 *centuries* = 1 *myrianary.*

Descending scale.

1 *day* = 10 *chrones.*
1 *chrone* = 100 *minutes* or *primes.*
1 *minute* = 100 *seconds.*

The effect of this mode of computation would be to destroy the labour of arithmetical reduction in all calculations founded upon the same unit of time.

Thus, the same figures which express 12405 years also express 1 myrianary, 24 centuries, and 5 years; 3 days, 7 chrones, 9 minutes, and 84 seconds = 370984 seconds; the only difference consisting in the joining or disjoining the figures.

It is immaterial whether the series proceed by tens, hundreds, or thousands, provided that convenience be consulted.

Those who object to such a mode of computation in conjunction with our system of arithmetic are guilty of *downright logical inconsistency*, and, however numerous, deserve not the epithet of rational. On the contrary, they may be fairly said to lend their assistance to the illiberal in keeping up the barriers of science against the mass of mankind.

It is natural that the day should begin at midnight, "that it may comprehend in its duration all the" possible " time of the presence of the sun above the horizon."

The following, though not a strictly decimal division, is easily reducible to it, and at the same time more conformable to the European system.

1 *day* = 20 *hours*, or *half chrones.*
1 *hour* = 50 minutes, } the same as
1 minute = 100 seconds, } before.

The morning and evening hours may be distinguished from each other in writing, by expressing them as continued from midnight. Thus, *5* would signify *5* in the morning; but 1*5*, *5* in the evening.

This mode of distinction would be more simple than that of A.M. or P.M.

It is remarkable that the decimal second is nearly equal to the interval of time between the natural beats of the pulse.

Universal Meridian.

Since the sun arrives at any given place before it arrives at the westward of that place, it is evident that the hours are naturally marked on the terrestrial globe from west to east, and consequently that the longitude should be reckoned from west to east only.

If there were but one island on the globe, it would be natural to choose the most western point of that island for a meridian, from which to reckon the longitudes of the places contained in it.

In the same manner, if there were several islands on the globe, it would be natural to choose for a meridian the most western point of the largest island.

Since, then, Cape Verd is the most western point of the largest island (the great eastern continent), it seems most natural to draw through this point our universal meridian.

Remark.—If the 10 arithmetical digits were substituted by 10 corresponding vowel sounds and the same number of consonants, methodically arranged, the longitude and latitude of any given place may be converted into a word, composed of consonants and vowel sounds alternately.

By this method, when the mere name of any place is known, its position on the globe is also known, without the assistance of geographical tables.

This method furnishes a universal nomenclature, not only for places, but also for persons. A person may have two names; the one *geographical,* the other *chronological:* the former being derived from the place of his birth, and the latter, derived from the time of his birth, converted into letters in the same manner.

Thus also would many chronological tables become unnecessary; the mere name calling to mind the time of the birth of any person mentioned in history.

Such a hint as the above might not be altogether useless, when mankind begin to take into consideration the grand scheme of universal language. The true philanthropist, regarding posterity, and not merely himself, will steadily keep in view improvement however distant; and not hastily abandon altogether what may not be immediately attainable.

Of the Connexion of the Two Principal Unities of Time, or of the Formation of a Calendar.

As neither of the above-mentioned unities of time can be abandoned, the only plan to be adopted is to connect them. Hence the formation of a *calendar*.

The mean solar year is estimated = 365·242264 days. But as it would be inconvenient to compute by fractions, which would cause the year to begin at all hours of the day, hence the *civil* or *chronological year*, which is a convenient approximation to the mean solar year, consisting of an entire number of days. Hence also *intercalations*, which consist of an occasional introduction of a year of 366 days among those of 365.

With regard to the distribution into months of the 365 days of the civil solar year, two principal forms of calendar appear to have been adopted. These are the Egyptian and the Roman: the former consisting of 12 months of 30 days each, terminating with 5 supplementary days; the latter originally consisting of 12 months of 31 and 30 days alternately, with a slight exception.

If the origin of the year be fixed at any equinox or solstice, the Egyptian months are but ill suited to represent the four seasons of the year; as each following *trimestre*, or period of three months, anticipates by a continual increase of about 1¼ day that season with which it might be expected to correspond.

In the late French calendar the Egyptian months were employed to a better advantage; as the true equinoxes and solstices, being adopted instead of the mean ones, caused the trimestres to approximate to the true seasons; the longest of which, or summer season of the northern hemisphere, contained the supplementary days. The position of these days determined the origin of the year, in a manner the least arbitrary, for each side of the equator. But as this agreement would not always exist, a fresh position of the supplementary days, and a consequent fresh origin of the year would in time become necessary.

The Roman months, by being adjusted to the mean equinoxes and solstices, would not be chargeable with these defects; as by a more methodical arrangement they may consist of 30 and 31 days alternately, except the last month, which, containing but 30, would be fitted to receive the intercalary addition. But the inconstant number of days in the Roman month, by being inconvenient for the purposes of simple numeration and reduction, renders it on this account far inferior to the Egyptian, whose constant number 30 rolls on uninterrupted till the end of the year. Besides, when it is considered that the principal object of a calendar is to connect together the two unities of time, that mode seems entitled to be preferred by which this connexion can be most readily effected.

The following is a plan for the formation of a calendar in all probability entirely new.

If the middle of the 12 Egyptian months were fixed at a mean solstice, the 4 trimestres would approximate to the 4 mean seasons. At the end of these trimestres, the 5 supplementary days would complete the ordinary year.

The months of this calendar, being measured each way from a solstice, would at a mean rate show the corresponding altitudes of the sun, like the hours of the day measured each way from noon. On this account such a calendar may be called *equialtitude.*

Though the origin of the year is of less importance than the correspondence of the months with the seasons, yet even this may be settled in a manner the least arbitrary, by choosing for a middle solstice the summer solstice of the northern hemisphere. Thus would this calendar possess the most perfect analogy to the day, on that side of the equator containing the greatest quantity of land.

Here follows the arrangement of the equialtitude calendar in trimestres.

1st Trimestre.	Days.	2nd Trimestre.	Days.	3d Trimestre.	Days.	4th Trimestre.	Days.
Nivose	30	*Germinal*	30	*Messidor*	30	*Vendemiaire*	30
Pluviose	30	*Floreal*	30	*Thermidor*	30	*Brumaire*	30
Ventose	30	*Prairial*	30	*Fructidor*	30	*Frimaire*	30

Supplement 5 days,

to which is added the intercalary day when required, making 6 days in the years called *sextile.*

The ordinary years, having a supplement of 5 days, may, for distinction's sake, be called *quintile.*

The names of the French months are here used merely for the sake of distinguishing the equialtitude from the vulgar months. In the *adoption,* however, of any fresh calendar, it would be more advisable to use the vulgar names, than otherwise to run the risk of preserving *antagonist notions.*

Remark.—The supernumerary days may be made holidays; the middle of which would answer to Christmas-day, when december 25th, or 8th before the calends of january, was marked by the Romans as the day of the winter solstice.

Though of the mean equinoxes and solstices, all marked by the Romans on the 8th before the calends of the following months, the only one conforming to calculation is the summer solstice; by which the rest appear to have been regulated, and to have been fixed in like manner on the 8th before the calends.

This calculation refers to the establishment of the Julian calendar in A. D.—44; when, at the meridian of Rome, the mean summer solstice fell on june 24th.

In A. D. 1 the solstice continued to fall on june 24th at the meridians of both Rome and Cape Verd.

Intercalation.

By a settled law of intercalation, the origin of the civil year may be known in advance.

Approximate conjunctions of the instant of a solstice with midnight, for a given meridian, may be found to return after different periods of years. These conjunctions, which possess various degrees of accuracy, form *natural solar cycles*, by which intercalations may be regulated. Such, for instance, is the Persian cycle of 33 years, in which 8 intercalary days are introduced.

As, however, the Gregorian cycle agrees with the division of years into centuries, it may on this account be preferred, as it enables us to discover readily the intercalations, and greatly facilitates the reduction of years into days.

This cycle is artificially formed by introducing in 400 years 97 intercalations. One of these occurs at the end of each *olympiad*, or period of 4 years, except the ends of the 3 first centuries.

It has been proposed to omit the intercalation at the end of the 40th Gregorian century. But corrections of this kind should perhaps vary according to the acceleration of the solar year; as the Gregorian cycle appears to be the most accurate centurial one, that can be said to possess any degree of permanence.

Equation of Civil Years.

The following tables contain in chrones the errors of the Gregorian intercalation for upwards of 4000 years.

Errors in Chrones for

Years less than a Century.

Years elapsed.	Years of Olympiad.			
	1st.	2d.	3d.	4th.
0	0	−2	−5	−7
10	1	−1	−4	−6
20	2	0	−3	−5
30	3	1	−2	−4
40	3	1	−2	−4
50	4	2	−1	−3
60	5	3	0	−2
70	6	4	1	−1
80	6	4	1	−1
90	7	5	2	0

Entire Centuries elapsed.

	0	1	2	3
0	0	−2	−5	−7
4	1	−1	−4	−6
8	2	0	−3	−5
12	3	1	−2	−4
16	4	2	−1	−3
20	5	3	0	−2
24	6	4	1	−1
28	7	5	2	0
32	8	6	3	1
36	9	7	4	2
40	9	7	4	2

Construction of the Tables.

As 365 days anticipate the mean solar year by about 2½ chrones, the mean solstices for the 3 last years of an olympiad fall later by 2, 5, and 7 chrones respectively, omitting fractions.

As after 40 civil years the solstice falls earlier by about 3 chrones, the increase of 1 chrone is placed after every 10th year, except the 40th.

The table for the centuries is constructed in the same manner, where after 40 centuries the solstice falls earlier by about 9 chrones. If the intercalary day be then omitted, the solstice would fall later by about 1 chrone.

When the civil year anticipates the solstice, the chrones are marked in the tables with a minus sign.

In like manner tables may be constructed to show the errors of the civil calendar in hundredths of days.

Civil years, thus equated, would be brought to the same common standard; upon which, if thought proper, may be constructed tables of the equation of natural days, not requiring the trouble of calculating the sun's mean longitude.

Of the Era.

As nations vary in their mode of computing years, a *common era* becomes necessary, though merely to fix the scale of intercalation upon a universal basis.

It has been proposed to fix the origin of such an era in the year 1250; about which the solar apogee, or sun's greatest distance from the earth, coincided with the northern solstice.

But as it is perhaps difficult to trace a conjunction of this sort to the exact year, something more definite may be required.

In the following year, at the proposed universal meridian, the instant of the northern solstice made the nearest approach to midnight that occurred within 33 years of that epocha.

This origin of a Persian cycle, which is more accurate than the Gregorian, may determine more definitely not only the origin of the era, but also that of the series of intercalation, whether the Persian or Gregorian be adopted.

Thus, the northern solstice, in 1251, falling at Cape Verd about the end of Julian june 14th, the year and era would begin 6 Egyptian months before this instant; that is, in 1250 at the termination of Julian dec. 16th, or Gregorian dec. 23d.

This year, in which the mean and true solstices may be said to coincide, affords a suitable point of departure for the equialtitude calendar, which is regulated by a solstice.

If a myrianary, or scale of 100 centuries, be applied so as to terminate at the origin of the proposed era, the inconveniences arising from a negative date would be avoided. On this account it may not be an improper substitute for the more arbitrary Julian period, so frequently adopted by chronologers.

History is generally distributed into chapters corresponding with the reigns of sovereigns. But as there is no coincidence in the reigns of cotemporary sovereigns, different histories cannot be so easily compared with each other, as when distributed into centuries and tens of years. These periods may also vary according to the national mode of computation, unless a common era be adopted.

According to this arrangement, it would be sufficient to express the two last figures of a date of years, provided that the number of the century be expressed at the top of the page.

With respect to the method of notation observed in dates, it seems most orderly to express the greater period of time before the next greater, and so on. This is conformable to what is already practised in abstract numeration, where thousands are expressed before hundreds, hundreds before tens, &c.

Also, as the names of the months are *common* and *not proper*, they do not seem entitled to begin with capital letters. When proper names are used as common ones, the mode of expression is not altered. Thus we write *a Newton* and *a Kant.* In like manner, it appears that if the common names of months are used as proper ones, the same mode of reasoning may be applied.

According to this plan, instead of writing 15th Jan. 1828, we should write 1828 jan. 15th; after which, if necessary, may follow hours, minutes, and seconds.

When the names of the months are expressed numerically, the ordinary plan appears as absurd as that of expressing a sum of money in the order of pence, shillings, and pounds, instead of that of pounds, shillings, and pence.

As, for the ordinary purposes of life, a universal calendar may be united to the customary national mode of computing years, the application of the proposed intercalation to the vulgar or Dionysian era may be seen, either in the table of Sunday letters or in the following rule:

Increase or diminish, as most convenient, by 50, the two last figures of the given year.

Reject the highest multiple of 4 contained in the result; the excess, 1, 2, 3, or 0, above which, will be accordingly the 1st, 2d, 3d, or 4th year of the olympiad.

Years ending with 50 are quintile, unless the preceding figures be a multiple of 4.

Example.

What year of the olympiad is A. D. 1828?

$$
\begin{array}{l}
\ \ 28 \\
+50 \\
\hline
=78 \\
-76 \text{ (highest multiple of 4)} \\
\hline
=2= \text{ year of olympiad.}
\end{array}
$$

Chronological Table of the Principal Eras used in History, compared with the Apogean Computation.

It must be observed, that the following table refers not to events, but to the epochas, or origins of eras, used by different nations and historians, whether such epochas be true or false.

Dionysian Era.	Julian Period.	Myrianary Period.	
—4713	0	4037	Julian period 0[*].
—3760	953	4990	Vend. 2. Mean Jewish era begins, at the autumnal equinox[†].
—3101	1612	5649	Pluv. 1. Cali-yng begins (J. feb. 18, G. jan. 23.[‡])
—775	3938	7975	Mess. 1. Mean Olympic era begins, at the summer solstice[†].
—753	3960	7997	Roman era 0[§].
—746	3967	8004	Pluv. 28. Era of Nabonassar begins (feb. J. 26, G. 18.[‖])
—513	4200	8237	Nab. 234 begins niv. 1[¶].

---

[*] When no month is expressed, the years of the Dionysian era and Julian period are supposed to coincide with the equialtitude calendar.

[†] As these years are lunisolar, a mean is chosen. Stranchius's Chronology, translated by Sault, 2d edition, Chambers's Dict. 5th edition, art. Epocha.

[‡] The Hindoo year exceeds the Julian by 7 days, or the Gregorian by 13 days, in 800 years. Asiatic Researches, 8vo. vol. vi. pp. 544 and 588.

[§] The Varronian date used in the proclamations of the emperors, the years beginning with january. Stranch. p. 252.

[‖] These are Egyptian years of 365 days each. Chamb. art. Epocha. Stranch. p. 405.

[¶] The three following years also coincide.

Dionysian Era.	Julian Period.	Myrianary Period.	
0	4713	8750	Dionysian era 0.
622	5335	9372	Mess. 28. Hegira begins (july J. 16, G. 19.*)
632	5345	9382	Prair. 28. Era of Yesdegird begins (june J. 16, G. 19.†)
641	5354	9391	Heg. 20 begins niv. 1.
967	5680	9717	Heg. 356 approximates ‡.
991	5704	9741	Nab. 1739 begins niv. 1. §
1250	5963	10000	Apogean era 0.
		Apogean Era.	
1293	6006	43	Heg. 692 approximates.
1363	6076	113	Yesd. 731 begins niv. 1. §
1619	6332	369	Heg. 1028 approximates.
1792	6505	542	Vend. 4. French republican era begins (G. sept. 22.)

---

* Chamb. art. Epocha. Stranch. p. 48.

† These are Egyptian years of 365 days each. Chamb. art. Epocha. Stranch. p. 405.

‡ As the mean Turkish year = $354\frac{11}{30}$ days, 326 mean Gregorian years exceed 336 mean Turkish years by 1·855 day. So that, in the intervals of the approximations, 3 per cent. may be subtracted from the Turkish years, in order to reduce them to the Gregorian.

§ The three following years also coincide.

Chronological Table of Improvements in the Sciences and Arts.

The following is an abridged table, chiefly extracted from Hutton's Mathematical Recreations.

Dionysian Era.	Julian Period.	Apogean Myrianary.	
605	5318	9355	Use of bells introduced into churches.
660	5373	9410	Organs first used in churches.
663	5376	9413	Glass invented by a bishop.
		Apogean Era.	
1299	6012	49	Spectacles invented by a monk of Pisa.
1302	6015	52	Mariners' compass invented or improved by Flavio.
1417	6130	167	Paper made of linen rags invented.
1450	6163	200	First book printed with moveable type*.
1459	6172	209	Engraving and etching invented.
1464	6177	214	Decimal fractions in arithmetic and a *decimal division of the radius* introduced about this time by John Muller, alias Regiomontanus†.
1488	6201	238	Cape of Good Hope discovered.
1492	6205	242	America discovered by Columbus.
1522	6235	272	First voyage round the world by Magellan.
1540	6253	290	Variation of the compass discovered by Cabot.
1590	6303	340	Telescopes invented by Jansen, a spectacle-maker of Holland.
			Art of weaving stockings invented by Lee in Cambridge.

---

* Gregory's Dictionary, art. *Printing.* Brady's Clavis Calendaria, vol. ii. p. 196.

† Hutton's Dictionary, arts. *Decimals* and *Muller.*

Dionysian Era.	Julian Period.	Apogean Era.	
1610	6323	360	Thermometers invented by Drebbel, a Dutchman.
			Galileo first observed 3 of Jupiter's satellites.
1614	6327	364	Logarithms invented by Napier of Scotland.
1619	6332	369	Circulation of the blood discovered by Hervey.
1630	6343	380	Gazettes first published at Venice.
1631	6344	381	Vernier introduced his scale*.
			Brum. 29. Transit of Mercury over the sun's disk first observed by Gassendi (G. nov. 17).
1639	6352	389	Frim. 16. Transit of Venus observed by Horrox (J. nov. 24, G. dec. 4).
1643	6356	393	Barometers invented by Toricelli.
1649	6362	399	Galileo first applied the pendulum to clocks.
1654	6367	404	Air-pump invented by Otto Gueric of Magdeburg.
1655	6368	405	Huygens first discovered a satellite of Saturn.
1665	6378	415	Magic lantern invented by Kircher.
1680	6393	430	Anatomy of plants made known by Grew.
1686	6399	436	Newton's principles of natural philosophy published.
1727	6440	477	Aberration of the fixed stars discovered and accounted for by Bradley.
1781	6494	531	Kant published his "Critic of Pure Reason †."
			New planet discovered by Herschel.
1795	6508	545	*A decimal division of the quadrant,* and a decimal system of weights and measures, founded on the terrestrial quadrant, introduced into France ‡.
1801	6514	551	Another new planet discovered by Piazzi.
1802	6515	552	Ditto by Olbers.

---

* Hutton's Dictionary, art. *Vernier*.

† Willich on Kant's writings.

‡ Brisson sur les Poids et Mesures.

Reduction of the Gregorian to the Equialtitude Calendar.

TABLE 1.

Letters of reference to table 2.

The columns marked B are bissextiles, having two letters; one serving till the end of february, and the other till the end of the year.

The columns marked S are sextiles; except the year marked Q, which is quintile.

Centurial years.
1600 . . . . *ba*
1700 . . . . *b*
1800 . . . . *b*
1900 . . . . *b*

1600	*a*	*a*	*b*	*ba*	*a*	*a*	*b*	*ba*
1700	*b*	*b*	*c*	*cb*	*a*	*a*	*b*	*ba*
1800	*b*	*b*	*c*	*cb*	*a*	*a*	*b*	*ba*
1900	*b*	*b*	*c*	*cb*	*a*	*a*	*b*	*ba*
Years less than a century.		S		B		S		B
	1	2	3	4			51	52
	5	6	7	8	53	54	55	56
	9	10	11	12	57	58	59	60
	13	14	15	16	61	62	63	64
	17	18	19	20	65	66	67	68
	21	22	23	24	69	70	71	72
	25	26	27	28	73	74	75	76
	29	30	31	32	77	78	79	80
	33	34	35	36	81	82	83	84
	37	38	39	40	85	86	87	88
	41	42	43	44	89	90	91	92
	45	46	47	48	93	94	95	96
	49	50 Q			97	98	99	
		1650 S						

This table may be continued backwards at pleasure, by subtracting 400 from the centurial years.

TABLE 2.

Numbers to be added to the given day of the Gregorian month to reduce it to equialtitude computation.

	a	*b*	*c*
Jan. Apr. May	9	8	7
Feb. June. July	10	9	8
Mar.	8	7	6
Aug.	11	10	9
Sept. Oct.	12	11	10
Nov. Dec.	13	12	11

The excess of a sum above 30 belongs to the following month.

In december, the excess of a sum above 35 or 36 belongs to the following year, according as the year exceeded is quintile or sextile.

Example. Let the date required be 1826 sept. 25.

In table 1, for 1826, letter of reference = *b*.

In table 2, under *b*, number for sept. = 11. Then, sept. 25

$$\begin{array}{r} 25 \\ +\ 11 \\ \hline =36 \end{array} = \text{equialtitude oct., or vend., 6.}$$

Correspondence of the Vulgar and Proposed Divisions of the Day.

No. 1. in the frontispiece represents the dial-plate of a twenty hour clock or watch. Ten of these hours are expressed, as well as the twelve vulgar hours to which they stand related.

This simple intuitive comparison would be sufficient for the purposes of the illiterate, who are often unjustly accused of being the enemies of rational innovation, by *those who wish to find excuses for their own prejudices.*

For the better informed, the minute-hand shows exclusively the 50 decimal minutes belonging to the new hour.

By means of figures or letters of reference the vulgar minutes may be discovered.

Thus, the diagram expresses in new time 2 minutes past 8: in old time, by the hour hand, about 20 minutes of *D* or 10, each of the divisions of the vulgar hour answering to 10 minutes. The latter divisions, being vulgar minutes for the minute hand, show the more exact vulgar time to be 21 minutes of 10, reckoned from the figure or letter of reference *d*, at which the minute-hand would arrive when the hour-hand reached the *D* before mentioned.

The hundred decimal seconds and days of the equialtitude months are omitted in the diagram, which is exhibited merely for the sake of illustration and comparison.

No. 2. also exhibits a sort of map or scheme of the equialtitude calendar, the months and days of which are, as it were, equally poised from the mean north solstice.

It has been said that schemes of this sort, however reasonable, are proposed when it is too late. Such an argument degrades man to the level of some inferior animal, if it can be daringly asserted that it is *too late for rational beings to improve!*

By the following rule, the vulgar hours and minutes may be arithmetically reduced to new ones, to the nearest tenth of a new minute.

Each new hour = 1 hour + 12 minutes (old). After having thrown out from the given time all the new hours contained in it, multiply by 7 the remaining minutes.

This product, diminished by the number of odd multiples of 9 contained in the preceding remainder, will be the new minutes expressed in tenths.

Example.

Reduce 4 ho. 16 min. (old) to new time.

$$\begin{array}{rrl} \text{From} & 4^{h}.\ 16^{m}. & \\ \text{Take} & 3\quad 36 & \text{(for 3 new ho.)} \\ \hline & 40 & \\ & \times\ 7 & \\ \hline & 280 & \\ & -\ 2 & \text{(No. of odd multiples of 9 in 40)} \\ \hline & 278 & \end{array}$$

Answer, 3 ho. 27·8 min. (new).

The cause of this process is, that 1 min. (old) = ·7 min. (new), except a slight error; which beyond 9 min. (old) exceeds the half of ·1 min. (new).

Here it may not be amiss to observe what an excellent opportunity is offered to governments to lay a tax, not upon improvement or comfort, but upon ignorance and prejudice.

It might be enacted, that all the present clocks and watches, purposely made to show the vulgar divisions of the day, should render their possessors, receiving a competent income, liable to pay the proposed tax.

A duty may be laid on all future clocks and watches, made upon the same plan, to be paid by all purchasers able to read and write, and understanding the four first rules of arithmetic.

Approximate Reduction of One Unit of Time to the Denomination of the Other Unit.

RULE I.

To reduce days to decimals of a year with 4 places.

Divide the given number of days by 4.

Add together the hundredth and thousandth parts of the quotient.

From the sum subtract at the rate of $\frac{12}{10,000}$ for each hundred of the given number.

This process saves the trouble of dividing by 365·24. For $\frac{1}{365 \cdot 24} = \frac{1}{91 \cdot 31}$ of $\frac{1}{4}$; and $\frac{1}{91 \cdot 31}$ nearly = ·011, or $\frac{1}{100} + \frac{1}{1000}$.

Example 1.

Reduce 365·24 days to the decimal of a year.

4)365·24
91·31

·9131
+·0913
=1·0044
—·0044 (36 for 300, and 8 for 65)
=1·0000 = the answer.

Example 2.

Reduce 1 day to the decimal of a year.

4)1·00
·25

·0025
+·0002
=·0027 = the answer.

Example 3.

Reduce 100 days.

4)100·00
25·00

·2500
+·0250
=·2750
—·0012
=·2738 = the answer.

Example 4.

Reduce 91·31 days.

4)91·31
22·83—

·2283
+·0228
=·2511
—·0011
=·2500 = the answer.

RULE II.

To reduce decimals of a year to days with 2 decimals.

Multiply the given decimal by 4.

Divide the product by ·011.

To the quotient add at the rate of $\frac{4}{10}$ for each unit of the preceding product.

This process is nearly the reverse of that used in the last rule, and saves the trouble of multiplying by 365·24.

Example 1.

Reduce 1·00000 of a year to days.

1·00000
×4
·011)4·00000
363·64–
+1·6 (4×·4)
=365·24 = the answer.

Example 2.

Reduce ·25 of a year to days.

·25000
×4
·011)1·00000
90·91
+·4
=91·31 = the answer.

Example 3.

Reduce ·002738 of a year.

·002738
×4
·011)·010952
·996—, or 1·00, = the answer.

Example 4.

Reduce ·083333 of a year.

·083333
×4
·011)·333332
30·303—

Brought up 30·303
+·133 (·333×·4)
30·436, or 30·44, = the answer.

Application of the preceding Rules to Decimal Coins.

RULE I.

To reduce annual payments to daily ones.

Divide the annual payment by 4.

Add together the hundredth and thousandth parts of the quotient.

From the sum subtract at the rate of 12 millionths of the annual payment.

Example 1.

10,000 francs per year, how much per day?

4)1,000,000 centimes.
250,000

2500
+250
=2750
−12
=2738 centimes = 27 francs 38 centimes = the answer.

Example 2.

36524 francs per year.

4)3652400 centimes.

913100

9131

+913

10044

−44 { 36 for 3 million, and 8 for 650,000.

10000 { centimes, or 100 francs, = the answer.

RULE II.

To reduce daily payments to annual ones.

Multiply the daily payment by 40.

Divide the product by 11.

To the quotient add at the rate of 4 ten thousandths of the preceding product.

The result will be in hundreds of the lowest given denomination.

Example 1.

100 francs per day, how much per year?

10,000 centimes.

×40

11)400,000

36364—

+ 160 (4×40)

36524 francs = the answer.

Example 2.

27 francs 38 centimes per day.

27 francs 38 centimes = 2738 centimes.
× 40
11)109520
9956
+44(4 × 11 for 110,000)
10,000 francs = the answer.

The preceding rules may also be applied in the same manner to decimal weights and measures.

The simplicity of these rules would be destroyed, by an application to other denominations foreign to the scale of our arithmetic. But such denominations are suited only to *barbarous nations, who obstinately adhere to the prejudices of their savage ancestors;* and who, if at all addicted to science, for the most part *idolize mere matter*, and *neglect all form and intelligibility*.

Equation of Natural Days.

Reduced from an equation table in Ferguson's Mechanics by Brewster.

The following table, which may be sufficiently accurate for ordinary purposes, contains, in tenths of decimal minutes, the equation of natural days for the noon of each 5th day of the year.

This answers to about the beginning of the 19th Dionysian, or middle of the 6th apogean, century.

As the 4th year of the olympiad is here made the standard, the remaining years may be reduced to it, by the addition of the following fractions to the given day of the month.

Years of olympiad . . 1st. 2d. 3d. 4th.
Corrections . . . . . . $\frac{3}{4}$. $\frac{1}{2}$. $\frac{1}{4}$. 0.

When no sign is prefixed to the equation, it is to be sought for at the head of the column.

D. Eq.
Niv. 0 . — ·4

Days.	Nivose. Eq.	D. Diff.	Pluviose. Eq.	D. Diff.	Ventose. Eq.	D. Diff.	Germinal. Eq.	D. Diff.
	+	·34	+	·16	+	·10	+	·22
5	1·3	·34	9·1	·12	9·2	·12	3·7	·20
10	3·0	·30	9·7	·06	8·6	·16	2·7	·22
15	4·5	·30	10·0	·04	7·8	·18	1·6	·20
20	6·0	·24	10·2	·02	6·9	·22	·6	·18
25	7·2	·22	10·1	·08	5·8	·20	— ·3	·14
30	8·3		9·7		4·8		—1·0	
Days.	**Floreal. Eq.**	**D. Diff.**	**Prairial. Eq.**	**D. Diff.**	**Messidor. Eq.**	**D. Diff.**	**Thermidor. Eq.**	**D. Diff.**
	—	·14	—	·06	+	·14	+	·02
5	1·7	·10	2·3	·08	1·5	·14	4·2	·00
10	2·2	·06	1·9	·12	2·2	·14	4·2	·06
15	2·5	·04	1·3	·12	2·9	·10	3·9	·08
20	2·7	·02	·7	·14	3·4	·08	3·5	·10
25	2·8	·04	0·0	·16	3·8	·06	3·0	·16
30	2·6		+ ·8		4·1		2·2	
Days.	**Fructidor. Eq.**	**D. Diff.**	**Vendemiaire. Eq.**	**D. Diff.**	**Brumaire. Eq.**	**D. Diff.**	**Frimaire. Eq.**	**D. Diff.**
	—	·16	—	·26	—	·10	—	·18
5	+1·4	·20	5·5	·22	10·8	·08	9·3	·20
10	+ ·4	·22	6·6	·22	11·2	·02	8·3	·26
15	·7	·22	7·7	·20	11·3	·02	7·0	·30
20	1·8	·24	8·7	·18	11·2	·08	5·5	·32
25	3·0	·24	9 6	·14	10·8	·12	3·9	·32
30	4·2		10·3		10·2		2·3	

D.D.
D. Eq. ·36
Supp^{t}. 5. — ·5
·35

To use the preceding table, add the correction to the given day of the month, according to the year of the olympiad, and find the day nearest to it in the table.

Then, according as the equation increases or decreases, reckon the daily difference from the equation in the table to answer to the day of the month corrected.

Example 1.

In 1st year of olympiad required the equation for nivose 6th at noon.

Niv. 6+correction=niv. $6\frac{3}{4}$.

m.
Niv. 5, eq. = + 1·3
+ 2 d. . . . . + ·7(for 2 × ·34, or 2 × daily diff.)
=7, do. = +2·0
$-\frac{1}{4}$ d. . . . −·1(for $\frac{1}{4}$ daily difference)
=niv. $6\frac{3}{4}$, eq. = + 1·9; or
1·9 *m.* to be added to apparent solar time.

Example 2.

In 2d year of olympiad required equation for brumaire 21st.

Brum. 21 + correction = brum. $21\frac{1}{2}$.

m.
Brum. 20, eq. = −11·2
+1 d. . . . . + ·1 (for ·08)
+ $\frac{1}{2}$ d. . . . . +·0
Brum. $21\frac{1}{2}$, eq. = −11·1.

By adjusting the equation to an apogean century, it is undisturbed by the centurial omission of the sextile year. By adjusting it to the middle of a century, the centurial variation is diminished one half.

NEW SYSTEM OF EPACTS.

The *mean synodic lunation,* or period of the moon's age, has been estimated = 29·530587953 days.

The moon's age, at the beginning of the year, is in chronology called the *epact;* which being determined, the origin of the lunation, like that of the year, may be known in advance.

The vulgar epacts are calculated in days. But as the possible error of a day is too great for so small a period as that of the lunation, it appears preferable to make use of the next lower denomination. The epact in chrones, or *decimal epact,* may be therefore chosen.

Simple Epacts.

By approximating to the ratio of the lunation to the solar year, a convenient ratio of 19 to 235 is discoverable, producing a cycle of 19 years.

Although this cycle is defective, it may nevertheless serve to depress the calculation of the epacts, which may be afterwards corrected.

As 19 civil years do not always contain the same number of intercalary days, which generally occur once in 4 years, the following *simple epacts* are calculated on the supposition that 1 lunar cycle = exactly 19 years, each of 365¼ days.

The numbers, indicating the years of this cycle, have been called *golden numbers.*

Table of Decimal Epacts answering to the 19 Golden Numbers and Vulgar Epacts.

Golden Numbers		XIX.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Epacts	Vulgar	0	11	22	3	14	25	6	17	28	9
	Decimal	0	109	218	31	140	249	62	171	280	93
Golden Numbers		X.	XI.	XII.	XIII.	XIV.	XV	XVI.	XVII.	XVIII.	
Epacts	Vulgar	20	1	12	23	4	15	26	7	18	
	Decimal	202	16	124	233	47	155	264	78	187	

To find the simple Vulgar Epact.

In the preceding table the lunar cycle sets out with the golden number 0, or 19.

By this arrangement, every golden number, which is a multiple of 3, = the vulgar epact.

The years of the lunar cycle, in which this occurs, may be called *years of coincidence.*

To the epacts of these years add 11 and 22, respectively, for the 1st and 2d years after coincidence. Reject 30, if the sum exceed it.

To find the simple Decimal Epact.

First find the vulgar epact, and place it under the denomination of days, marked D.

Opposite D write C, for the denomination of chrones., In the years of coincidence place, under C, $\frac{1}{3}$ of the golden number. To this add 1 in the last year of the cycle.

From the number under C subtract 1 and 2, respectively, for the 1st and 2d years after coincidence.

In cases where the number of days exceeds 30, add 3 to the number under C, instead of subtracting as otherwise.

The cause of this deviation from the other part of the rule is, that the subtraction of 30 days, for a lunation, is too much by 5 chrones; which number, diminished by 2 as before, = 3.

Example 1.

Required the decimal epact answering to the golden number 6.

D. C.
(Year of coincidence) 6 2 (or 62 chrones) = the answer.

Here the golden number 6, being a multiple of 3, expresses the number of days.

Its 3d part 2 also marks the chrones.

Example 2.

Required the epact for the golden number 18.

D. C.
(Year of coincidence) 18 6
+ 1 (for last year of cycle)
———
7 (or 187 chr.) = the ans.

Example 3.

Epact for golden number 10.

	D.	C.	
(Last year of coinc., or g. n. 9)	9	3	
(1st year after do.) . . .	11	−1	
	20	2	Ans.=202.

Example 4.

Epact for golden number 5.

	D.	C.	
(Last year of coinc., or g. n. 3)	3	1	
(2d year after do.)	22	−2	
	25	−1	Ans.=249.

Example 5.

Epact for golden number 2.

	D.	C.	
(Last year of coinc., or g. n. 0)	0	0	
	22	−2	
	22	−2	Ans.=218.

Example 6.

Epact for golden number 14.

	D.	C.	
(Last year of coinc., or g. n. 12)	12	4	
(2d year after do.) . . .	22 +	3	(for days exceeding 30.)
	4	7	
			Answ.=47.

Annual Correction of Epacts.

As the simple epacts are calculated on the supposition that each civil year =365¼ days, which in reality is not the case, it becomes necessary to reduce these equal, or mean Julian, years to the unequal or true ones, generally made use of in the calendar.

Because the true generally fall short of the mean by $\frac{1}{4}$ day, therefore, after setting out together, the true will anticipate the mean by the same continual increase; till the introduction of the intercalary day, which causes them to coincide as before, and resume the same order of differences.

The epact being the moon's age at the beginning of the year, and the true Julian year frequently beginning before the mean, the simple epacts must be diminished by the differences of these years, according to the following table:

Years of an Olympiad.	Differences in Days.	Differences in Chrones.
1st	0	0
2d	$\frac{1}{4}$	$2\frac{1}{2}$
3d	$\frac{1}{2}$	5
4th	$\frac{3}{4}$	$7\frac{1}{2}$

For the epacts in chrones the fractions may be omitted.

This diminution of the epact is its *annual correction;* which, being repeated in the same order, forms a *recurring epact.*

Centurial Correction of Epacts.

As the Julian year is occasionally corrected by the Gregorian omission of 3 days in 4 centuries, the suppression of each day diminishes accordingly the epact for the following year.

This diminution of the epact forms the centurial *metemptosis.*

At the end of 19 mean Julian years, the new moon falls earlier by about ·061831 of a day. This accordingly increases the simple epact, the error of which in one of these years amounts to $\frac{1}{19}$ of this anticipation, or about ·003254 of a day. This error, in 10,000 Julian years, amounting to 325 chrones, omitting fractions, is at the rate of $3\frac{1}{4}$ chrones in 1 Julian century, or 13 chrones in 4 of these centuries.

The latter increasing error forms the centurial *proëmptosis,* which may be introduced at the expiration of the following years:

Years.	Chrones.	Years.	Chrones.	Years.	Chrones.	Years.	Chrones.
25	1	125	1	225	1	325	1
50	1	150	1	250	1	350	1
75	1	175	1	275	1	375	1
100	0	200	0	300	0	400	1

As the centurial cycle of metemptosis corresponds with that of proëmptosis, the former diminishing the epact, while the latter, in a less degree, increases it, they may both be incorporated to form a consolidated negative correction.

It would be perhaps more convenient to take the complement of this negative correction, converting it into a positive one, the addition of which to the epact would constitute its *centurial correction,* as in the following table:

Quarters of Centuries elapsed.

Centuries elapsed.	0	1	2	3
0	0	1	2	3
1	288	289	290	291
2	281	282	283	284
3	274	275	276	277
4	278	279	280	281
5	271	272	273	274
&c.				

The differences of these numbers proceed in the regular order of 1, 1, 1, —10, till the beginning of another cycle of 4 centuries, whose first correction is increased by 1.

When the number to be diminished is less than 10, add to it a lunation, or 295 chrones, and subtract as before.

Application of the Epacts to the Equialtitude Calendar.

According to M. Rivard, in his Treatise on the Calendar, Father Meliton, in the year 1740, proposed that the epacts should mark the full moons instead of the new ones. For the half lunation = about 14¾ days. So that when the new moons are well marked by the epacts in days, the full moons, which are of greater importance, will be badly indicated.

But as the moon's age is reckoned from the new and not from the full moon, it would be perhaps more convenient to fix the origin of the lunation

for chronological purposes 15 entire days before the full moon, and to adjust the epacts accordingly. This mode of computing the days of the lunation would bear an analogy to the equialtitude calendar.

It may also be observed, that, estimating the lunation = 29½ days exactly, the full moons, if well marked by the epacts at the beginning of the year, would be badly indicated at the end of the year. It therefore appears preferable to take a mean between these two extremes, and to adjust the epacts so as to well indicate the full moon in the neighbourhood of the north solstice.

The decimal epact, answering to the golden number 1, = 109. At the origin of the proposed era, the moon's age, computed as above, exceeded 109 by about 105 chrones. It appears, therefore, more convenient that the centurial correction should set out with 105, than to alter the simple epacts, which may be considered as perpetual, and corresponding with golden numbers setting out from the same epocha.

In conformity to the preceding plan the following tables are constructed.

Abridged Table of proposed Golden Numbers from A. D. 1000 *to A. D.* 2500.

	Years less than a Century.									
	00	10	20	30	40	50	60	70	80	90
1000	16	7	17	8	18	9	19	10	1	11
1100	2	12	3	13	4	14	5	15	6	16
1200	7	17	8	18	9	19	10	1	11	2
1300	12	3	13	4	14	5	15	6	16	7
1400	17	8	18	9	19	10	1	11	2	12
1500	3	13	4	14	5	15	6	16	7	17
1600	8	18	9	19	10	1	11	2	12	3
1700	13	4	14	5	15	6	16	7	17	8
1800	18	9	19	10	1	11	2	12	3	13
1900	4	14	5	15	6	16	7	17	8	18
2000	9	19	10	1	11	2	12	3	13	4
2100	14	5	15	6	16	7	17	8	18	9
2200	19	10	1	11	2	12	3	13	4	14
2300	5	15	6	16	7	17	8	18	9	19
2400	10	1	11	2	12	3	13	4	14	5

for chronological purposes 15 entire days before the full moon, and to adjust the epacts accordingly. This mode of computing the days of the lunation would bear an analogy to the equialtitude calendar.

It may also be observed, that, estimating the lunation = $29\frac{1}{2}$ days exactly, the full moons, if well marked by the epacts at the beginning of the year, would be badly indicated at the end of the year. It therefore appears preferable to take a mean between these two extremes, and to adjust the epacts so as to well indicate the full moon in the neighbourhood of the north solstice.

The decimal epact, answering to the golden number 1, = 109. At the origin of the proposed era, the moon's age, computed as above, exceeded 109 by about 105 chrones. It appears, therefore, more convenient that the centurial correction should set out with 105, than to alter the simple epacts, which may be considered as perpetual, and corresponding with golden numbers setting out from the same epocha.

In conformity to the preceding plan the following tables are constructed.

sed Golden Numbers ***from***
to A. D. 2500.

ss than a Century.						
0	40	50	60	70	80	90
8	18	9	19	10	1	11
3	4	14	5	15	6	16
8	9	19	10	1	11	2
4	14	5	15	6	16	7
9	19	10	1	11	2	12
4	5	15	6	16	7	17
9	10	1	11	2	12	3
5	15	6	16	7	17	8
0	1	11	2	12	3	13
5	6	16	7	17	8	18
1	11	2	12	3	13	4
6	16	7	17	8	18	9
1	2	12	3	13	4	14
6	7	17	8	18	9	19
2	12	3	13	4	14	5

for chronological purposes 15 entire days before the full moon, and to adjust the epacts accordingly. This mode of computing the days of the lunation would bear an analogy to the equialtitude calendar.

It may also be observed, that, estimating the lunation = $29\frac{1}{2}$ days exactly, the full moons, if well marked by the epacts at the beginning of the year, would be badly indicated at the end of the year. It therefore appears preferable to take a mean between these two extremes, and to adjust the epacts so as to well indicate the full moon in the neighbourhood of the north solstice.

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	Years less than a Century.									
	00	10	20	30	40	50	60	70	80	90
1000	16	7	17	8	18	9	19	10	1	11
1100	2	12	3	13	4	14	5	15	6	16
1200	7	17	8	18	9	19	10	1	11	2
1300	12	3	13	4	14	5	15	6	16	7
1400	17	8	18	9	19	10	1	11	2	12
1500	3	13	4	14	5	15	6	16	7	17
1600	8	18	9	19	10	1	11	2	12	3
1700	13	4	14	5	15	6	16	7	17	8
1800	18	9	19	10	1	11	2	12	3	13
1900	4	14	5	15	6	16	7	17	8	18
2000	9	19	10	1	11	2	12	3	13	4
2100	14	5	15	6	16	7	17	8	18	9
2200	19	10	1	11	2	12	3	13	4	14
2300	5	15	6	16	7	17	8	18	9	19
2400	10	1	11	2	12	3	13	4	14	5

for chronological purposes 15 entire days before the full moon, and to adjust the epacts accordingly. This mode of computing the days of the lunation would bear an analogy to the equialtitude calendar.

It may also be observed, that, estimating the lunation = 29½ days exactly, the full moons, if well marked by the epacts at the beginning of the year, would be badly indicated at the end of the year. It therefore appears preferable to take a mean between these two extremes, and to adjust the epacts so as to well indicate the full moon in the neighbourhood of the north solstice.

The decimal epact, answering to the golden number 1, = 109. At the origin of the proposed era, the moon's age, computed as above, exceeded 109 by about 105 chrones. It appears, therefore, more convenient that the centurial correction should set out with 105, than to alter the simple epacts, which may be considered as perpetual, and corresponding with golden numbers setting out from the same epocha.

In conformity to the preceding plan the following tables are constructed.

Abridged Table of proposed Golden Numbers from A. D. 1000 *to A. D.* 2500.

	Years less than a Century.									
	00	10	20	30	40	50	60	70	80	90
1000	16	7	17	8	18	9	19	10	1	11
1100	2	12	3	13	4	14	5	15	6	16
1200	7	17	8	18	9	19	10	1	11	2
1300	12	3	13	4	14	5	15	6	16	7
1400	17	8	18	9	19	10	1	11	2	12
1500	3	13	4	14	5	15	6	16	7	17
1600	8	18	9	19	10	1	11	2	12	3
1700	13	4	14	5	15	6	16	7	17	8
1800	18	9	19	10	1	11	2	12	3	13
1900	4	14	5	15	6	16	7	17	8	18
2000	9	19	10	1	11	2	12	3	13	4
2100	14	5	15	6	16	7	17	8	18	9
2200	19	10	1	11	2	12	3	13	4	14
2300	5	15	6	16	7	17	8	18	9	19
2400	10	1	11	2	12	3	13	4	14	5

for chronological purposes 15 entire days before the full moon, and to adjust the epacts accordingly. This mode of computing the days of the lunation would bear an analogy to the equialtitude calendar.

It may also be observed, that, estimating the lunation = $29\frac{1}{2}$ days exactly, the full moons, if well marked by the epacts at the beginning of the year, would be badly indicated at the end of the year. It therefore appears preferable to take a mean between these two extremes, and to adjust the epacts so as to well indicate the full moon in the neighbourhood of the north solstice.

The decimal epact, answering to the golden number 1, = 109. At the origin of the proposed era, the moon's age, computed as above, exceeded 109 by about 105 chrones. It appears, therefore, more convenient that the centurial correction should set out with 105, than to alter the simple epacts, which may be considered as perpetual, and corresponding with golden numbers setting out from the same epocha.

In conformity to the preceding plan the following tables are constructed.

Abridged Table of proposed Golden Numbers from A. D. 1000 *to A. D.* 2500.

	Years less than a Century.									
	00	10	20	30	40	50	60	70	80	90
1000	16	7	17	8	18	9	19	10	1	11
1100	2	12	3	13	4	14	5	15	6	16
1200	7	17	8	18	9	19	10	1	11	2
1300	12	3	13	4	14	5	15	6	16	7
1400	17	8	18	9	19	10	1	11	2	12
1500	3	13	4	14	5	15	6	16	7	17
1600	8	18	9	19	10	1	11	2	12	3
1700	13	4	14	5	15	6	16	7	17	8
1800	18	9	19	10	1	11	2	12	3	13
1900	4	14	5	15	6	16	7	17	8	18
2000	9	19	10	1	11	2	12	3	13	4
2100	14	5	15	6	16	7	17	8	18	9
2200	19	10	1	11	2	12	3	13	4	14
2300	5	15	6	16	7	17	8	18	9	19
2400	10	1	11	2	12	3	13	4	14	5

To find the Golden Number for a given Year of any Era.

Reject the highest number of centuries ending with the golden number 19.

The excess of 400 years, above the lunar cycles contained in them, = 1.

The excess of 100 years, above the same, = 5.

The excess of 20 years, above the same, = 1.

The sum of these excesses, rejecting the cycles contained in it, = the golden number.

Example.

The golden number for A. D. 300 = 19; required that for 1828.

1828		
−300		
	Excesses.	
1528		
−1200 - -	3	
328		
−300 - -	15	19 rejected.
28		
−20 - -	1	
8 - -	8	

Sum = 8 = the answer.

Table of Sunday Letters and Years of the Olympiad, for the Equialtitude Calendar, from A. D. 1250 *to A. D.* 2050.

The years ending with 50, marked S and Q, are sextile and quintile accordingly.

Years of Olympiad.	Years less than a Century.					1250+ 1300+ 1650+ 1700+ 00, *d.* 50, *S.*	1350+ 1400+ 1750+ 1800+ 00, *f.* 50, *Q.*	1450+ 1500+ 1850+ 1900+ 00, *A.* 50, *Q.*	1550+ 1600+ 1950+ 2000+ 00, *c.* 50, *Q.*
1		7	35	51	79	*b*	*d*	*f*	*A*
2		8	36	52	80	*A*	*c*	*e*	*g*
3		9	37	53	81	*g*	*b*	*d*	*f*
4		10	38	54	82	*f*	*A*	*c*	*e*
1		11	39	55	83	*d*	*f*	*A*	*c*
2		12	40	56	84	*c*	*e*	*g*	*b*
3		13	41	57	85	*b*	*d*	*f*	*A*
4		14	42	58	86	*A*	*c*	*e*	*g*
1		15	43	59	87	*f*	*A*	*c*	*e*
2		16	44	60	88	*e*	*g*	*b*	*d*
3		17	45	61	89	*d*	*f*	*A*	*c*
4		18	46	62	90	*c*	*e*	*g*	*b*
1		19	47	63	91	*A*	*c*	*e*	*g*
2		20	48	64	92	*g*	*b*	*d*	*f*
3		21	49	65	93	*f*	*A*	*c*	*e*
4		22	50	66	94	*e*	*g*	*b*	*d*
1		23		67	95	*c*	*e*	*g*	*b*
2		24		68	96	*b*	*d*	*f*	*A*
3		25		69	97	*A*	*c*	*e*	*g*
4		26		70	98	*g*	*b*	*d*	*f*
1		27		71	99	*e*	*g*	*b*	*d*
2		28		72	00	*d*	*f*	*A*	*c*
3	1	29		73		*c*	*e*	*g*	*b*
4	2	30		74		*b*	*d*	*f*	*A*
1	3	31		75		*g*	*b*	*d*	*f*
2	4	32		76		*f*	*A*	*c*	*e*
3	5	33		77		*e*	*g*	*b*	*d*
4	6	34		78		*d*	*f*	*A*	*c*

Table of Recurring Epacts in Chrones according to the Proposed Golden Number and Year of the Olympiad.

Golden Numbers.	Years of the Olympiad.				Golden Numbers.	Years of the Olympiad.			
	1st.	2d.	3d.	4th.		1st.	2d.	3d.	4th.
I	109	107	104	102	XI	16	14	11	9
II	218	216	213	211	XII	124	122	119	117
III	31	29	26	24	XIII	233	231	228	226
IV	140	138	135	133	XIV	47	45	42	40
V	249	247	244	242	XV	155	153	150	148
VI	62	60	57	55	XVI	264	262	259	257
VII	171	169	166	164	XVII	78	76	73	71
VIII	280	278	275	273	XVIII	187	185	182	180
IX	93	91	88	86	XIX	0	293	290	288
X	202	200	197	195					

Table of the Centurial Correction in Chrones, for the Equialtitude Calendar, from A. D. 1000 *to A. D.* 2500.

	Years less than a Century.			
	0+	25+	50+	75+
1000	117	118	* 108	109
1100	110	111	* 101	102
1200	103	104	* * 105	106
1300	107	108	* 98	99
1400	100	101	* 91	92
1500	93	94	* 84	85
1600	86	87	* * 88	89
1700	90	91	* 81	82
1800	83	84	* 74	75
1900	76	77	* 67	68
2000	69	70	* * 71	72
2100	73	74	* 64	65
2200	66	67	* 57	58
2300	59	60	* 50	51
2400	52	53	* * 54	55

Nivose.

M.D.	W.D.	N.D.	F.D.
1	*A*	29	14
2	*b*	28	13
3	*c*	27	12
4	*d*	26	11
5	*e*	25	10
6	*f*	24	9
7	*g*	23	8
8	*A*	22	7
9	*b*	21	6
10	*c*	20	5
11	*d*	19	4
12	*e*	18	3
13	*f*	17	2
14	*g*	16	1
15	*A*	15	
16	*b*	14	29
17	*c*	13	28
18	*d*	12	27
19	*e*	11	26
20	*f*	10	25
21	*g*	9	24
22	*A*	8	23
23	*b*	7	22
24	*c*	6	21
25	*d*	5	20
26	*e*	4	19
27	*f*	3	18
28	*g*	2	17
29	*A*	1	16
30	*b*	29	15

Pluviose.

M.D.	W.D.	N.D.	F.D.
1	*c*	28	14
2	*d*	27	13
3	*e*	26	12
4	*f*	25	11
5	*g*	24	10
6	*A*	23	9
7	*b*	22	8
8	*c*	21	7
9	*d*	20	6
10	*e*	19	5
11	*f*	18	4
12	*g*	17	3
13	*A*	16	2
14	*b*	15	1
15	*c*	14	29
16	*d*	13	28
17	*e*	12	27
18	*f*	11	26
19	*g*	10	25
20	*A*	9	24
21	*b*	8	23
22	*c*	7	22
23	*d*	6	21
24	*e*	5	20
25	*f*	4	19
26	*g*	3	18
27	*A*	2	17
28	*b*	1	16
29	*c*	29	15
30	*d*		14

Ventose.			
M. D.	W. D.	N. D.	F. D.
1	*e*	28	13
2	*f*	27	12
3	*g*	26	11
4	*A*	25	10
5	*b*	24	9
6	*c*	23	8
7	*d*	22	7
8	*e*	21	6
9	*f*	20	5
10	*g*	19	4
11	*A*	18	3
12	*b*	17	2
13	*c*	16	1
14	*d*	15	
15	*e*	14	29
16	*f*	13	28
17	*g*	12	27
18	*A*	11	26
19	*b*	10	25
20	*c*	9	24
21	*d*	8	23
22	*e*	7	22
23	*f*	6	21
24	*g*	5	20
25	*A*	4	19
26	*b*	3	18
27	*c*	2	17
28	*d*	1	16
29	*e*	29	15
30	*f*	28	14

Germinal.			
M. D.	W. D.	N. D.	F. D.
1	*g*	27	13
2	*A*	26	12
3	*b*	25	11
4	*c*	24	10
5	*d*	23	9
6	*e*	22	8
7	*f*	21	7
8	*g*	20	6
9	*A*	19	5
10	*b*	18	4
11	*c*	17	3
12	*d*	16	2
13	*e*	15	1
14	*f*	14	29
15	*g*	13	28
16	*A*	12	27
17	*b*	11	26
18	*c*	10	25
19	*d*	9	24
20	*e*	8	23
21	*f*	7	22
22	*g*	6	21
23	*A*	5	20
24	*b*	4	19
25	*c*	3	18
26	*d*	2	17
27	*e*	1	16
28	*f*	29	15
29	*g*	28	14
30	*A*		13

Floreal.

M.D.	W.D.	N.D.	F.D.
1	*b*	27	12
2	*c*	26	11
3	*d*	25	10
4	*e*	24	9
5	*f*	23	8
6	*g*	22	7
7	*A*	21	6
8	*b*	20	5
9	*c*	19	4
10	*d*	18	3
11	*e*	17	2
12	*f*	16	1
13	*g*	15	
14	*A*	14	29
15	*b*	13	28
16	*c*	12	27
17	*d*	11	26
18	*e*	10	25
19	*f*	9	24
20	*g*	8	23
21	*A*	7	22
22	*b*	6	21
23	*c*	5	20
24	*d*	4	19
25	*e*	3	18
26	*f*	2	17
27	*g*	1	16
28	*A*	29	15
29	*b*	28	14
30	*c*	27	13

Prairial.

M.D.	W.D.	N.D.	F.D.
1	*d*	26	12
2	*e*	25	11
3	*f*	24	10
4	*g*	23	9
5	*A*	22	8
6	*b*	21	7
7	*c*	20	6
8	*d*	19	5
9	*e*	18	4
10	*f*	17	3
11	*g*	16	2
12	*A*	15	1
13	*b*	14	29
14	*c*	13	28
15	*d*	12	27
16	*e*	11	26
17	*f*	10	25
18	*g*	9	24
19	*A*	8	23
20	*b*	7	22
21	*c*	6	21
22	*d*	5	20
23	*e*	4	19
24	*f*	3	18
25	*g*	2	17
26	*A*	1	16
27	*b*		15
28	*c*	29	14
29	*d*	28	13
30	*e*	27	12

Messidor.

M.D.	W.D.	N.D.	F.D.
1	*f*	26	11
2	*g*	25	10
3	*A*	24	9
4	*b*	23	8
5	*c*	22	7
6	*d*	21	6
7	*e*	20	5
8	*f*	19	4
9	*g*	18	3
10	*A*	17	2
11	*b*	16	1
12	*c*	15	
13	*d*	14	29
14	*e*	13	28
15	*f*	12	27
16	*g*	11	26
17	*A*	10	25
18	*b*	9	24
19	*c*	8	23
20	*d*	7	22
21	*e*	6	21
22	*f*	5	20
23	*g*	4	19
24	*A*	3	18
25	*b*	2	17
26	*c*	1	16
27	*d*	29	15
28	*e*	28	14
29	*f*	27	13
30	*g*	26	12

Thermidor.

M.D.	W.D.	N.D.	F.D.
1	*A*	25	11
2	*b*	24	10
3	*c*	23	9
4	*d*	22	8
5	*e*	21	7
6	*f*	20	6
7	*g*	19	5
8	*A*	18	4
9	*b*	17	3
10	*c*	16	2
11	*d*	15	1
12	*e*	14	29
13	*f*	13	28
14	*g*	12	27
15	*A*	11	26
16	*b*	10	25
17	*c*	9	24
18	*d*	8	23
19	*e*	7	22
20	*f*	6	21
21	*g*	5	20
22	*A*	4	19
23	*b*	3	18
24	*c*	2	17
25	*d*	1	16
26	*e*		15
27	*f*	29	14
28	*g*	28	13
29	*A*	27	12
30	*b*	26	11

Fructidor.			
M.D.	W.D.	N.D.	F.D.
1	*c*	25	10
2	*d*	24	9
3	*e*	23	8
4	*f*	22	7
5	*g*	21	6
6	*A*	20	5
7	*b*	19	4
8	*c*	18	3
9	*d*	17	2
10	*e*	16	1
11	*f*	15	29
12	*g*	14	28
13	*A*	13	27
14	*b*	12	26
15	*c*	11	
16	*d*	10	25
17	*e*	9	24
18	*f*	8	23
19	*g*	7	22
20	*A*	6	21
21	*b*	5	20
22	*c*	4	19
23	*d*	3	18
24	*e*	2	17
25	*f*	1	16
26	*g*	29	15
27	*A*	28	14
28	*b*	27	13
29	*c*	26	12
30	*d*	25	11

Vendemiaire.			
M.D.	W.D.	N.D.	F.D.
1	*e*	24	10
2	*f*	23	9
3	*g*	22	8
4	*A*	21	7
5	*b*	20	6
6	*c*	19	5
7	*d*	18	4
8	*e*	17	3
9	*f*	16	2
10	*g*	15	1
11	*A*	14	29
12	*b*	13	28
13	*c*	12	27
14	*d*	11	26
15	*e*	10	25
16	*f*	9	24
17	*g*	8	23
18	*A*	7	22
19	*b*	6	21
20	*c*	5	20
21	*d*	4	19
22	*e*	3	18
23	*f*	2	17
24	*g*	1	16
25	*A*		15
26	*b*	29	14
27	*c*	28	13
28	*d*	27	12
29	*e*	26	11
30	*f*	25	10

Brumaire.

M. D.	W. D.	N. D.	F. D.
1	*g*	24	9
2	*A*	23	8
3	*b*	22	7
4	*c*	21	6
5	*d*	20	5
6	*e*	19	4
7	*f*	18	3
8	*g*	17	2
9	*A*	16	1
10	*b*	15	
11	*c*	14	29
12	*d*	13	28
13	*e*	12	27
14	*f*	11	26
15	*g*	10	25
16	*A*	9	24
17	*b*	8	23
18	*c*	7	22
19	*d*	6	21
20	*e*	5	20
21	*f*	4	19
22	*g*	3	18
23	*A*	2	17
24	*b*	1	16
25	*c*	29	15
26	*d*	28	14
27	*e*	27	13
28	*f*	26	12
29	*g*	25	11
30	*A*	24	10

Frimaire.

M. D.	W. D.	N. D.	F. D.
1	*b*	23	9
2	*c*	22	8
3	*d*	21	7
4	*e*	20	6
5	*f*	19	5
6	*g*	18	4
7	*A*	17	3
8	*b*	16	2
9	*c*	15	1
10	*d*	14	29
11	*e*	13	28
12	*f*	12	27
13	*g*	11	26
14	*A*	10	25
15	*b*	9	24
16	*c*	8	23
17	*d*	7	22
18	*e*	6	21
19	*f*	5	20
20	*g*	4	19
21	*A*	3	18
22	*b*	2	17
23	*c*	1	16
24	*d*		15
25	*e*	29	14
26	*f*	28	13
27	*g*	27	12
28	*A*	26	11
29	*b*	25	10
30	*c*	24	9

Supplement.			
M. D.	W. D.	N. D.	F. D.
1	*d*	23	8
2	*e*	22	7
3	*f*	21	6
4	*g*	20	5
5	*A*	19	4
6	*b*	18	3

The following examples will illustrate the above.

Example 1st.

Let the epact for a given year = 164 chrones.

This in days may be called 16 +. Then suppose it be required to know the day of the chronological new moon in germinal.

As 16 answers to the end of the 12th, 16 + answers to the 12th in the evening.

Example 2nd.

Let the epact = 167 chrones.

This in days may be called 17 —.

Required the day of the full moon in floreal.

As 17 answers to the noon of the 26th, 17 — answers to the 26th in the evening.

Example 3d.

Epact in days = 9 +.

Required new and full moons in messidor.

Answer. Full moon on the 3d in the evening. New moon on the 18th in the morning.

Example 4th.

Epact for A. D. 1827 = 255 chrones, or 25½ days.

Required full moon in nivose and new moon in pluviose.

Answer. Full moon on nivose 19th at midnight; new moon on pluviose 4th at noon.

Example 5th.

Epact in days for A. D. 1828 = 7 –.

Required full moon in messidor.

Answer. Full moon on the 6th in the morning.

From the preceding Epacts in Days to find the Moon's Age arithmetically.

Add together the epact, ½ the number of months elapsed, and the days elapsed of the given month.

Subtract 29½ when the sum exceeds it, or add ½ and subtract 30.

Example.

Required the moon's age 1827 thermidor 5th at noon.

Days.
Epact for 1827 = $25\frac{1}{2}$
$\frac{1}{2}$ numb. of months elapsed = $3\frac{1}{2}$
Days elapsed of thermidor = $4\frac{1}{2}$

$33\frac{1}{2}$
$+\frac{1}{2}$
-30

= 4 = the answer.

When the epact is an exact number of half days, the half days of the moon's age answer to noon and midnight. But when the epact is followed by + or −, the half days of the moon's age answer to morning and evening.

If the epact be followed by +, the morning or evening of the given day of the month must be considered as expired. But if the epact be followed by −, the said morning or evening must be considered as not begun.

This is merely transposing to the day of the month the excess or deficiency of the epact in days.

Example 1st.

Epact = 16 +. Required the moon's age on germinal 12th in the evening.

Days.
Epact = 16
$\frac{1}{2}$ number of months elapsed = $1\frac{1}{2}$
Days of germ. supposed elap. = 12

= $29\frac{1}{2}$ = the answer.

$$\begin{array}{ll}
\text{Here } & 16 + x \\
 & + 1\tfrac{1}{2} \\
 & + 12 - x \\
\hline
 & = 29\tfrac{1}{2}
\end{array}$$

Example 2nd.

Epact = 17 −. Required the moon's age on floreal 26th in the evening.

$$\begin{array}{rr}
 & \text{Days.} \\
\text{Epact} = & 17 \\
\tfrac{1}{2}\text{ number of months elapsed} = & 2 \\
\text{Days of floreal supposed elap.} = & 25\tfrac{1}{2} \\
\cline{2-2}
 & 44\tfrac{1}{2} \\
 & + \tfrac{1}{2} \\
 & - 30 \\
\cline{2-2}
 & = 15 = \text{the answer.}
\end{array}$$

$$\begin{array}{ll}
\text{Here } & 17 \quad - x \\
 & + 2 \\
 & + 25\tfrac{1}{2} + x \\
\hline
 & = 44\tfrac{1}{2}, \text{ \&c.}
\end{array}$$

Rising and Setting of the Moon.

The moon's ecliptical rising and setting may be found perhaps near enough for ordinary purposes by the following table.

The moon's age is computed as above, and the time expressed in new hours and minutes.

☽'s Age.			
−N.	+N.		
R. by Day.	S. by Day.		
S. bef ⊙ R.	R. aft. ⊙ S.	N.	H. M.
15	15	0	0.. 0
14½	15½	6	0..17
14	16	12	0..34
13½	16½	18	1.. 1
13	17	24	1..18
12½	17½	31	1..35
12	18	37	2.. 2
11½	18½	43	2..19
11	19	49	2..36
10½	19½	55	3.. 3
10	20	62	3..20
9½	20½	68	3..37
9	21	74	4.. 4
8½	21½	80	4..21
8	22	86	4..38

☽'s Age.			
+N.	−N.		
R. by Day.	S. by Day.		
S. aft. ⊙ S.	R. bef. ⊙ R.	N.	H. M.
7½	22½	89	4..46
7	23	83	4..29
6½	23½	77	4..12
6	24	71	3..45
5½	24½	65	3..28
5	25	58	3..11
4½	25½	52	2..44
4	26	46	2..27
3½	26½	40	2..10
3	27	34	1..43
2½	27½	27	1..26
2	28	21	1.. 9
1½	28½	15	0..42
1	29	9	0..25
½	29½	3	0.. 8

The 3d column of the table, marked N, contains numbers of days to be reckoned forwards or backwards from the given day of the month in the calendar, according to the moon's age.

Then if M = the given day of the month, the table refers the moon's rising and setting on M to the sun's rising and setting of M ± N.

Example 1st.

Required moon rising on floreal 5th, moon's age being = 20d.

In table, under N, opposite moon's age 20 is 62; which is also opposite 3h. 20m. in the 4th column.

Then on flor. 5, with moon's age 20, moon rises 3h. 20m. after the sun set of (flor. 5 + 62 or) mess. 7.

Example 2nd.

Required moon setting on brumaire 14th, moon's age being = $12\frac{1}{2}$d.

Under N, opposite moon's age $12\frac{1}{2}$, is 31; which is also opposite 1h. 35m.

Then on brum. 14, with moon's age $12\frac{1}{2}$, moon sets 1h. 35m. before the sun rise of (brum. 14—31 or) vend. 13.

The progression in the 4th column is the difference of the moon's culminating, or coming to the meridian, amounting in 3 half days to 1h. 1m.

The 3d column contains days of a lunation valued in proportional parts of a year, expressed in days; 5 half days of the former amounting to 31 days of the latter.

By the application of these numbers, the moon's rising and setting are referred to that part of the calendar, in which the sun has either the equal or opposite longitude to that of the moon.

THE END.

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